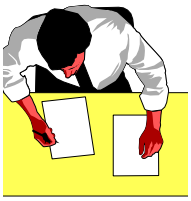
Hydrologic Center Engineering

ADVANCES

IN HYDROLOGIC ENGINEERING

Summer 2000



Director's Comments

It has been a while since our last newsletter, and much has happened since – both in an organizational and product context. I will comment on organization matters, and make a brief comment on HEC priorities and projects. Other articles in this newsletter provide more detailed information about HEC projects and products.

For some time, I have been writing that realignment in HEC's parent structure was under study and the outcome was imminent. The 'imminent' time frame kept being postponed, and postponed, and postponed (several years) but now the result is in hand. Since 1979, HEC has been an organization within the Water Resources Support Center (WRSC), with headquarters located in the Washington DC National Capitol Region (NCR). Other sister organizations in WRSC included the Institute for Water Resources (IWR), physically located in the NCR, and the Navigation Data Center, headquartered in the NCR with it's Waterborne Commerce Statistics Center (WCSC) located in New Orleans, LA. As of July 16, 2000, WRSC no longer exists. The consequence is that the organizations of WRSC have been integrated into a 'new' IWR that results in an Institute that has six organization units. Two of the organizations are HEC and NDC, and the other four are previous 'old' IWR units. We at HEC remain intact in terms of mission, FTEs, staff, location, and for the most part, authorities. Our finance and accounting and other business processes are being integrated into IWR processes, and we are actively working to develop closer associations with the other units within the Institute. We believe that the new IWR will become much more than the sum of the previous parts.

Because change was afoot during this time of transition, we took advantage of the window-of-opportunity afforded and looked hard at HEC's structure for opportunities to improve our self. As a consequence we have reorganized HEC from the previous four divisions to three divisions structured to meet HEC organization needs from now into the future. The prior four divisions (Research, Training, Planning Analysis, and Technical Assistance) had existed since 1972. The three new divisions are: Water Management Systems, Hydrology and Hydraulics Technology, and Water Resource Systems. Responsibilities of the divisions are:

Water Management Systems (Art Pabst, Chief): Water control management technology; real-time data acquisition, communication, and management; Corps Water Management System (CWMS) applications and support; hydrology and hydraulics forecasting; reservoir regulation; and HEC software engineering and Information Technology management and administration.

Water Resource Systems (Mike Burnham, Chief): Reservoir systems analysis; water resource systems optimization; flood damage analysis; risk-based analysis; river/ecosystem restoration; watershed studies; and training program administration.

continued on page 7

IN THIS ISSUE . . .

TRAINING

HEC FY 2001 Training Program

The annual PROSPECT survey has been completed. HEC will conduct 10 PROSPECT training courses in FY 2001. This represents an increase over the last three years's average of six courses. The table below lists the courses, quota (number of signups versus course size), tuition and scheduled course dates. Several courses still have openings. While they are presented for Corps personnel, others are encouraged to take the courses when space is available. Priority is given to Federal, then State and Local agencies, then the private sector.

Course descriptions are provided in the "Purple Book" for Corps offices. A short description is also provided on HEC's web site. To obtain enrollment information, contact Huntsville Training and Operations by calling (265) 895-7421, or in writing to:

USA Corps of Engineers
ATTN: CEHR-P-TR
PO BOX 1600
Huntsville AL 35807

(Burnham)

HEC FY 2001 Training Schedule

Control Number	Course Name (Short Title)	Quota	Tuition	Date
123	Flood Frequency Analysis	18/30	1770	23-27 October 2000
114	Basic HEC-RAS	26/30	1560	13-17 November 2000
219	GIS for Hydrologic Engineering	29/30	1680	4-8 December 2001
178	Basic HEC-HMS	35/30	1700	22-26 January 2001
057	Hydrologic Engineering for Planning	23/30	1840	5-9 February 2001
316	Flood Damage Analysis with GIS	29/30	1760	12-16 March 2001
188	Unsteady Flow - HEC-RAS	27/30	1710	2-6 April 2001
164	Water and the Watershed	35/30	1780	7-11 May 2001
369	Advanced HEC-HMS	19/30	1880	20-24 August 2001
161	River & Wetlands Restoration	42/30	1920	10-14 September 2001

Vern Bonner, Chief of Training Division Retires

On July 1, 2000 Vern Bonner retired from his position as Chief of HEC's Training Division, a position he held for twenty years. As Chief of the Training Division, Vern not only directed HEC's large and diverse training program he was also responsible for the management of the Center's publications and video tape library. In addition, he served as the HEC webmaster. He was a frequent and enthusiastic lecturer in HEC's PROSPECT courses and in workshop sessions presented in Corps field offices. Vern's friendly stage presence and his subtle use of humor allowed him to effectively present otherwise dry technical material. Students frequently remarked that Vern was one of the best instructors they had encountered in Corps training sessions.

Under Vern's direction the Training Division designed and developed HEC's NexGen river hydraulics program, HEC-RAS and reservoir system analysis program, HEC-RES. He was also responsible for the widely applied predecessor programs HEC-2 and HEC-5. In addition, he served on the Technical Advisory Committee guiding the development of the USBR program "RiverWare." His professional activities included membership in AWRA, ASCE, and the Association of State Flood Plain Managers. Prior to joining the HEC in 1971, Vern was employed as a Civil Engineer by the California Department of Water Resources and the University of California, Davis. He is a 1962 graduate of California State University, Fresno.

Vern and his wife Ellie have retired to the San Diego region to enjoy the closeness of family and the gentle ocean-side climate. *(Hayes)*

PUBLICATIONS

Ordering Publications

Corps offices may request documentation via correspondence, e-mail, fax, or telephone. The request must include the recipient's name, office symbol, mailing address and telephone number. Documents should be requested by their HEC number or name.

All others may order from NTIS by writing to: *National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161*, calling their sales desk at *(703) 605-6000* or by accessing their web site at:

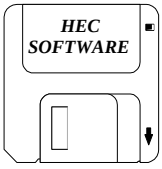
http://www.ntis.gov.

Some documents are available on-line and may be retrieved from our web site at:

http://www.hec.usace.army.mil

These documents are available in Adobe Portable Document Format (PDF). *(Garcia)*

SOFTWARE



Release of Beta HEC-RAS, Version 3.0

A new version of HEC-RAS has been released for beta testing. This version includes unsteady flow routing capabilities, as well as several new features for steady flow water surface profile computations. The following is a list of the new features:

A. Unsteady Flow Routing Features

1. The **Unsteady Flow Data Editor** allows the user to enter boundary conditions and the initial state of the system.

2. The **Unsteady Flow Simulation Manager** is used to set up an unsteady flow simulation. The user defines a plan, establishes a time window, and selects other computational options.

3. The **Geometric Pre-Processor (HTAB)** converts the geometry data into a series of tables and rating curves. Cross sections are converted to tables of

elevation versus area, conveyance, and storage. Bridges, culverts, and weirs are converted into a family of rating curves that describe headwater, tailwater, and flow rate.

4. The **Output Post-Processor** calculates detailed hydraulic information for a set of specified time lines during the simulation period. The post-processor takes the computed flows and stages from the unsteady flow model and calculates all of the hydraulic variables required for detailed output.

5. We have added the ability to plot and tabulate both **stage and flow hydrographs**.

6. **Graphics Animation** - We have added the ability to animate the cross section, profile, and three-dimensional graphics. Animation consists of stepping through the computed results based on a user specified output interval.

7. **UNET Data Importer** - We have added the ability to import the geometry data from a UNET model (CSECT files). This option is available from the File menu of the Geometric Data Editor.

B. New Geometric Data Features

The following new features are found in the Geometric Data Editor. They work for unsteady and steady flow computations.

1. **Lateral weirs and gated spillways** allow the user to remove flow from the main river through gated structures or uncontrolled over flow weirs. Lateral weirs and gated spillways can be connected to a storage area or another river reach.

2. **Lateral rating curves** option allows the user to enter elevation vs. flow rating curve for flow leaving the main river. A lateral rating curve is used to send flow to another reach or out of the system.

3. **Storage areas** are used to define an area where water ponds. They are often used to model off-channel storage or an area behind a levee.

4. **Hydraulic Connections** are used to pass flow between storage areas or between a storage area and another reach through the use of culverts and/or a weir.

5. **Cross-Sectional Points Filter** allows the user to reduce the number of points in a cross section by using a near point filter and a collinear line filter.

C. Split Flow Optimization

We have added the ability to perform split flow optimization in the steady flow water surface profile computation program. This option allows for flow splits at junctions, as well as lateral weirs and gated spillways. The program optimizes the division of flow through an iterative scheme of computing profiles and evaluating flow splits.
(Brunner)

The Continued Evolution of HEC-HMS

Users have asked about the status of HEC-HMS development and about the new software design as compared to HEC-1. The following article describes the software design and development process.

HEC-HMS is very different from HEC-1 in the software engineering sense. The program is object-oriented, combining data and functions in smart objects. Messaging is used to communicate between separate pieces of the program and weld the interface to the simulation engine. Though it draws on no less than 30 years of experience with HEC-1, it is still a relatively young program. We are adding capabilities and working out bugs at the same time.

HEC-HMS has several important advantages over HEC-1. It provides a fully integrated environment for developing precipitation and observed flow data, creating basin and meteorologic models, entering parameter data, performing simulations, estimating parameters, and viewing results. The graphical user interface that controls the computing environment allows nearly seamless movement between separate components and eliminates the need to memorize card identifiers and parameter lists. Instant reusability of gages, basin models, and precipitation models greatly reduces the amount of time necessary to obtain results. An error messaging system within the simulation engine provides specific feedback when input data are incorrect. Finally, the optimization manager provides powerful parameter estimation tools for building a more accurate and faster model.

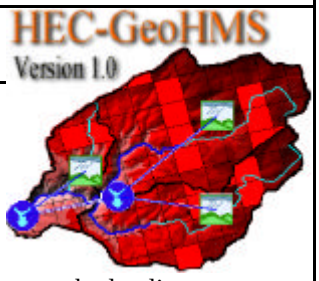
Version 2.0 was released in March 2000 following Version 1.1 and 1.0 in 1999 and 1998, respectively. Version 2.0 included a number of changes from the earlier versions. The precipitation model was renamed meteorologic model to reflect the addition of evapotranspiration. The depth-duration data interpolation was changed from parabolic to linear. The combined area and baseflow

global editor was replaced with a subbasin global editor and three separate global editors for each baseflow method. The initial loss specification for the SCS curve number method was changed to allow a value of zero. The components and project data accessed from the edit menu on the project definition screen were separated into separate menus for component and data.

Version 2.0 also includes several new capabilities. Continuous simulation capabilities were enhanced with the addition of the soil moisture accounting loss rate method. The method implements a five-layer linear storage model that includes specification of canopy interception, surface depression, soil profile, and two groundwater layers. Precipitation modeling capabilities were also enhanced by allowing gridded precipitation to be used with transform methods other than ModClark. The meteorologic model is capable of automatically computing area-weighted precipitation for a subbasin from gridded precipitation and a grid-cell file. Additionally, gridded loss rate and transform parameters were added to the optimization manager and stage-discharge tables were added to hydrologic elements.

HEC is devoted to increasing the capability and robustness of HEC-HMS. All new feature and enhancement suggestions received in writing from any program user are carefully evaluated. Enhancements to the program are prioritized by the number of users who will benefit. All bug reports are thoroughly investigated. The program user who reports a substantiated bug is notified when the problem is corrected and a new program version containing the repair is released. *(Scharffenberg)*

Release of HEC-GeoHMS, Version 1.0



The Geospatial Hydrologic Modeling Extension (HEC-GeoHMS) is a software package for use with the ArcView Geographic Information System. HEC-GeoHMS uses ArcView and Spatial Analyst to develop a number of hydrologic modeling inputs. Analyzing the digital terrain information, HEC-GeoHMS transforms the drainage paths and watershed boundaries into a hydrologic data structure that represents the watershed response to precipitation. In addition to the hydrologic data structure, capabilities include the development of grid-based data for linear quasi-distributed runoff transformation (ModClark), HEC-HMS basin model, physical watershed and stream characteristics to be used in developing hydrologic model parameters, and a background map file.

HEC-GeoHMS provides an integrated work environment with data management and customized toolkit capabilities, which includes a graphical user interface with menus, tools, and buttons. The program features terrain-preprocessing capabilities in both interactive and batch modes. Additional capabilities allow users to construct hydrologic elements at desired locations such as stream gages, hydraulic structures, and other control points. The basin schematic from HEC-GeoHMS is then imported by the Hydrologic Modeling System, HEC-HMS, where data and parameters are added and simulation is performed.

HEC-GeoHMS is available for Windows 95/98/2000/NT operating systems. It was completed in August 2000 and will be distributed in September. *(Doan)*

OTHER ARTICLES

HEC Performs Hydrologic Modeling for the Sacramento and San Joaquin River Basins

Due to several large and damaging flood events on the Sacramento and San Joaquin Rivers (California) during the 1980's and 1990's, the U.S. House of Representatives directed the Sacramento District to develop comprehensive plans for flood control for the two rivers and to develop hydrologic and hydraulic models of the river systems. The Sacramento and San Joaquin River watersheds comprise nearly 60,000 square-miles, drain California's

central valley floor and receive much of their runoff from the Sierra Nevada mountain range. Developing hydrologic models for the watersheds which included extremely variable terrain, and to do it within a ten month time period was a formidable task. The District contacted HEC to assist with the development of these models.

HEC used the Hydrologic Modeling System program, HEC-HMS, and introduced the HEC-GeoHMS technology to perform the hydrologic study. HEC-GeoHMS is an ArcView Extension that performs automatic subbasin delineation and calculates many of the physical characteristics required for the estimation of runoff parameters. HEC developed and calibrated thirty-two individual HEC-HMS models for the main tributaries and portions of the valley floors of the Sacramento and San Joaquin systems which included over 32,000 square miles and did so within a ten month period.

HEC-GeoHMS was used to delineate the individual river basins, to perform initial subbasin delineation and to develop the physical characteristics for the subbasins. Tools within HEC-GeoHMS allow the modelers to redelineate their subbasins as appropriate. Keeping the modeling effort consistent was critical to the success of the study. HEC developed modeling guidelines that each of the eleven modeling teams followed.

Once the grid based HEC-HMS models were developed, HEC contracted with Cold Regions Research and Engineering Laboratory (CRREL) to perform a snowmelt study for the two watersheds. HEC provided a gridded precipitation file (2x2km) to CRREL. Through the use of their Distributed Snow Process Model (DSPM), CRREL provided a gridded snowmelt/precipitation file to HEC. DSPM computes snowmelt and rainfall depths at the soil surface on a grid-cell basis. This data is used directly by HEC-HMS as precipitation on the watershed. The ModClark rainfall to runoff transformation was used to compute the hydrographs.

Before the detailed HEC-HMS models could be populated, parameter optimization models were developed at the hourly flow gages for the unregulated headwater streams. The optimization analyses allowed the modelers to develop best-estimate runoff parameters that were necessary for the regression analysis with basin characteristics. A number of physical characteristics and a basin factor (the product of the longest flow path and the centroidal flow path divided by the square root of the sub-basin slope) were evaluated for correlation with variations in Clark's TC for the optimization models. The results of the regression analysis allowed the modelers to populate the ungaged subbasins. Approximately 200 hourly flow gages and 75 reservoir gages were used to help calibrate the models. The thirty-two individual basin models were then given to the Sacramento District.

The Sacramento and San Joaquin hydrologic modeling effort was HEC's first large scale attempt to develop hydrologic models using gridded data sets and HEC-GeoHMS. Because of the size of the project and the short time frame, the models had to be developed efficiently and consistently across a large geographic area. HEC-HMS and HEC-GeoHMS proved to be significant assets in completing this study on schedule. *(Dunn)*

Corps Water Management System (CWMS)

HEC is involved in the development of the Corps' Water Control Modernization Program, named Corps Water Management System, or CWMS (previously called WCDS). The water management mission of the Corps is to regulate river flow with Corps projects to provide national benefits of flood control, navigation, hydroelectric power generation, water supply, irrigation, and other purposes. The CWMS is the automated information system (AIS) that supports the Corps of Engineers water control mission including the hardware, software, man-power and other resources required to acquire, develop, maintain, operate, and manage the system. The CWMS includes the collection, acquisition, retrieval, verification, storage, display, transmission, dissemination, interpretation and archival of data and information needed to carry out the water control mission of the Corps. The CWMS is nearing the end of its software development cycle, and is to be deployed to field offices starting in the later part of 2001.

In the past several years, new data sources for input to real-time regulation decisions have become available, including Geographic Information Systems (GIS) and NEXRAD radar data. Advances in software, taking advantage of these

data sources and new and improved analytical analysis methods, implemented within state-of-the-art computer processing and network systems, provide the critical element in improved information for water control decisions. New simulation modeling programs have been developed and implemented within the CWMS framework. These include modifications to HEC-HMS to incorporate spatial precipitation data available from NEXRAD for forecasting flow, a new reservoir simulation program (HEC-RES) with optimization algorithms for reservoir regulation, modifications to HEC-RAS to incorporate unsteady flow algorithms, and a new economic/flood damage impact program suite (HEC-FIA) to evaluate the effects of reservoir operation decisions.

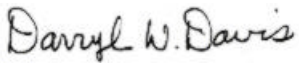
These simulation modeling programs are bundled together into the control and visualization interface (CAVI), along with tools to view data and control incoming data streams. The CAVI uses a geo-spatial referenced map to display observed data and computed results, as well as a control panel to execute and control the simulation models. The CAVI was developed using client-server architecture, with the client side running on a Microsoft Windows PC and the server on a Sun Solaris computer. This allows the CAVI to be executed for a watershed, and aid in the operational decision process, from locations across the country. *(Charley)*

Director's Comments - *Continued from Cover*

Hydrology and Hydraulics Technology (Arlen Feldman, Chief): Surface water hydrology; river hydraulics; land surface erosion and sediment transport; hydrologic statistics; groundwater hydrology; water quality; drought and low flow; and research program administration.

On the product side, the Water Control Data System (renamed Corps Water Management System) and NexGen software development projects remain our highest priority activities. We continued work on several significant field funded reimbursable projects, and are at work on new R&D and reimbursable projects. The result is that FY 2000 work efforts and funding are above that of recent years, making this our busiest and highest income year yet.

With the organization change, stable and capable staff, and robust workload, we at HEC intend to continue our tradition of strong commitment and support to our customers and users of our products.



Darryl W. Davis, P.E.
Director

Employment Opportunities

HEC will be recruiting to fill a number of vacant engineering positions in the coming months. Positions will range from entry level GS-7/9/11 to journeyman and senior position at the GS-12 and 13 levels. Technical specialties areas that will be recruited will likely be reservoir systems analysis, watershed hydrology, river hydraulics, and hydrologic statistics development and applications.

At the higher grades, we will be seeking candidates with practical, field experience in studies and applications in the areas noted. These positions will be recruited through the Corps' automated personnel system, so it is necessary that interested candidates be registered in the system serving HEC.

For administrative guidance about the job opportunities you may contact Diane Cuming, *Administrative Officer*. For technical aspects of the opportunities, you may contact Darryl Davis, *Director*, Mike Burnham, *Chief of Water Resource Systems Division*, Art Pabst, *Chief of Water Managment Systems Division*, or Arlen Feldman, *Chief of Hydrology and Hydraulics Technology Division. (Davis)*

US Army Corps of Engineers

Published Quarterly by
INSTITUTE FOR WATER RESOURCES
Hydrologic **E**ngineering **C**enter
609 Second Street
Davis, CA 95616-4687
(530) 756-1104 - Voice
(530) 756-8250 - FAX
cewrc-hec@usace.army.mil - E-mail
http://www.hec.usace.army.mil - WWW Homepage

ADVANCES in Hydrologic Engineering is published quarterly as a service to the Corps of Engineers and others interested in recent accomplishments of the Center. This bulletin is published in accordance with AR 25-30.

Administrative Document Hardcopy Mailings to Cease

As of August 2000, HEC will no longer provide hard-copy distribution of its administrative documents. These documents are HEC's annual and quarterly reports and include this Newsletter.

Future issues will be made available on our web site. In addition, the newsletter will be made available in electronic format via e-mail distribution. If you wish to continue to personally receive the HEC Newsletter, please submit your request by sending your e-mail address to josefina.d.garcia-moreno@usace.army.mil by 31 October 2000. *(Garcia)*

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, INSTITUTE FOR WATER RESOURCES
Hydrologic Engineering Center
609 Second Street
Davis, CA 95616-4687